

What is claimed is:

- Sub B2
1. A method to separate ethanol from a fermentation broth, which comprises:
- providing a fermentation vessel within which ethanol and carbon dioxide are produced, and
- providing a mixture of microorganisms, nutrients and sugars to form a volume of broth contained within said fermentation vessel, and
- subjecting said broth within said fermentation vessel to fermentation to form ethanol and carbon dioxide, and
- providing a controlled flow rate of gaseous carbon dioxide to said fermentation vessel to humidify ethanol to regulate concentration of ethanol within the broth to between about 6% to about 12%, and
- separating the carbon dioxide, containing humidified ethanol and carbon dioxide produced by fermentation, from the fermentation vessel, and
- removing means for separation of ethanol from the separated humidified carbon dioxide to substantially remove ethanol from carbon dioxide to provide carbon dioxide to humidify ethanol, and
- separating sludge and broth from said fermentation vessel, and
- providing said mixture, to replace the volume of separated sludge and broth, to maintain substantially constant volume of broth within the fermentation vessel thereby removing ethanol within broth, to regulate concentration of ethanol, and removing carbon dioxide from the fermentation vessel.
2. The method of claim 1 wherein said fermentation broth contains nutrients employed for fermentation substantially maintained to provide nutrients utilized within fermentation.
3. The method of claim 1 wherein said fermentation broth is established at a temperature and maintained at substantially isothermal conditions.
4. The method of claim 1 wherein said sugars, capable of fermentation within which ethanol and carbon dioxide are produced, are selected from the group consisting of glucose and xylose and mixtures thereof.
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5. The method of claim 1 wherein said carbon dioxide, containing humidified ethanol and carbon dioxide produced by fermentation, contains ethanol vapor produced from heat formed during fermentation.
6. The method of claim 1 wherein the microorganisms are yeasts capable of forming enzymes required for fermentation to form ethanol and carbon dioxide.
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7. The method of claim 1 wherein said fermentation vessel is operated in a continuous manner.
8. The method of claim 1 wherein said sludge and broth removed from said fermentation vessel are settled within a vessel to substantially separate broth from sludge.
9. The method of claim 8 wherein the broth separated from the sludge is combined with said mixture of microorganisms, nutrients and sugars to maintain volume of broth within said fermentation vessel.
10. The method of claim 1 wherein the microorganisms are capable of forming enzymes required for fermentation to form ethanol and carbon dioxide.
11. The method of claim 1 wherein said humidified carbon dioxide, containing ethanol, is scrubbed by a solvent to provide a solution containing ethanol and to provide carbon dioxide.
12. The method of claim 1 wherein said humidified carbon dioxide, containing ethanol, is scrubbed by water to provide a solution containing ethanol and to provide carbon dioxide humidified by water.
13. The method of claim 12 wherein the solution containing ethanol is extracted by gasoline to produce an extractate of gasoline within dissolved ethanol and a solution substantially free of ethanol.
14. The method of claim 13 wherein the extractate is substantially dehydrated.
15. The method of claim 13 wherein the solution substantially free of ethanol is distilled to produce vapor and a raffinate.
16. The method of claim 1 wherein the carbon dioxide is humidified and saturated by water so that further humidification by the carbon dioxide will produce humidified ethanol from the fermentation broth without substantially producing humidified water from the fermentation broth.
17. The method of claim 1 wherein said humidified carbon dioxide, containing ethanol, is scrubbed by gasoline to provide gasohol containing ethanol and to provide carbon dioxide containing gasoline.
18. The method of claim 17 wherein the gasohol containing water is dehydrated by forming a hydrate and dehydrated gasohol.
19. The method of claim 17 wherein the gasohol containing water is dehydrated by distillation forming an azeotrope and dehydrated gasohol.
20. The method of claim 17 wherein the carbon dioxide containing gasoline is subjected to adsorption to form carbon dioxide substantially free of gasoline and an absorbate containing gasoline.

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